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(12) (19) (CA) **Demande-Application**

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(72) Gingras, Earl, CA
(72) Bélanger, Paul, CA
(71) Gingras, Earl, CA
(71) Bélanger, Paul, CA

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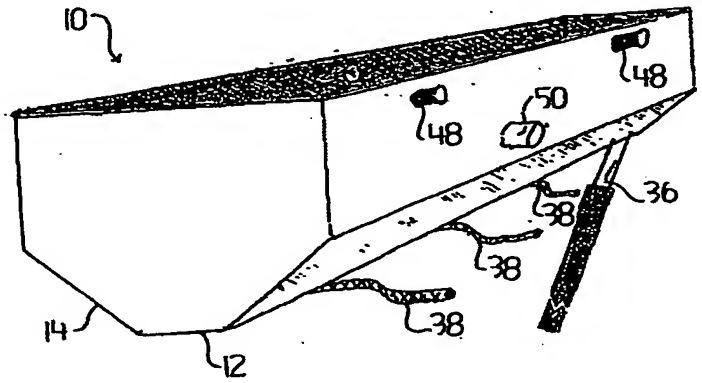
(54) **METHODE D'EXTRACTION DE PETROLE ET BITUME DES SABLES BITUMINEUX**

(54) **METHOD OF SEPARATING OIL AND BITUMEN FROM SAND**



(57) Une méthode pour séparer le pétrole et le bitume du sable. Premièrement, on mélange le sable contenant du pétrole et du bitume avec de l'eau dans un réservoir pour former une suspension aqueuse. Deuxièmement, on ajoute une solution aqueuse de peroxyde d'hydrogène à la suspension aqueuse que l'on agite. Le peroxyde d'hydrogène sert de catalyseur pour déclencher une réaction vigoureuse que sépare la suspension aqueuse en une couche supérieure d'écume, une couche intermédiaire d'eau propre et une couche inférieure de sable et d'argile propres. Troisièmement, on écume la couche contenant le pétrole et le bitume et on retire du réservoir la couche inférieure de sable propre et la couche intermédiaire d'eau propre.

(57) A method of separating oil and bitumen from sand. Firstly, mixing sand containing oil and bitumen with water in a tank to form an aqueous slurry. Secondly, adding a water solution of hydrogen peroxide to the aqueous slurry and agitating the aqueous slurry. The hydrogen peroxide serves as a catalyst initiating a vigorous reaction that separates the aqueous slurry into an upper froth layer, a middle clean water layer and a lower clean sand and clay layer. Thirdly, skimming the upper froth layer containing oil and bitumen and removing the lower clean sand layer and the middle clean water layer from the tank.

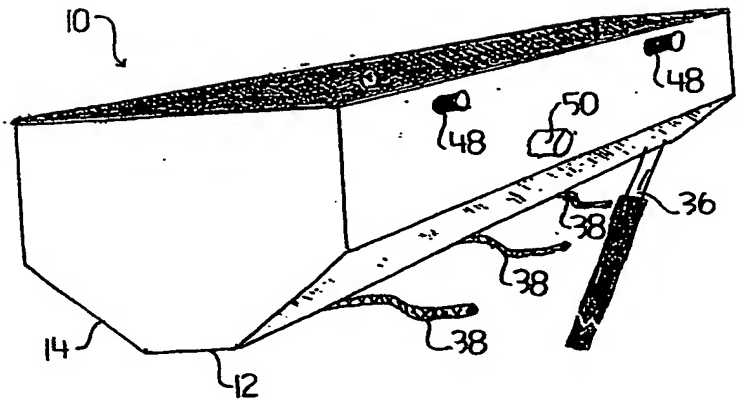


FIGURE 1

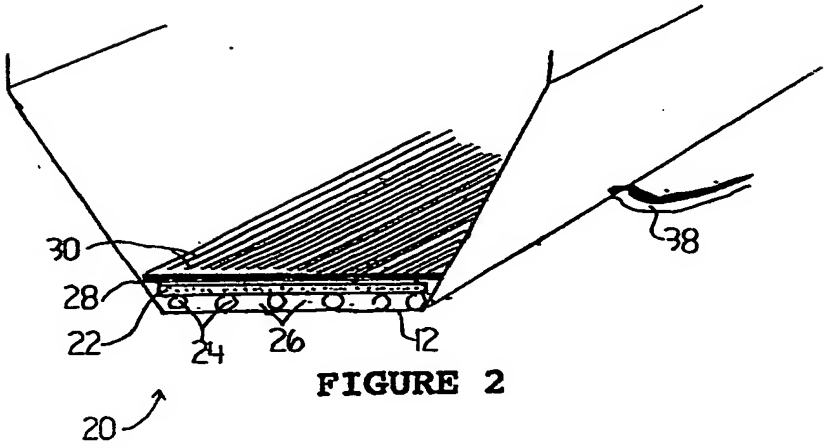


FIGURE 2

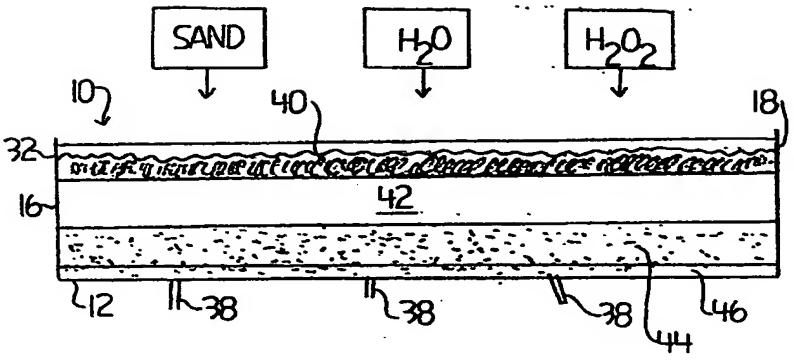


FIGURE 3

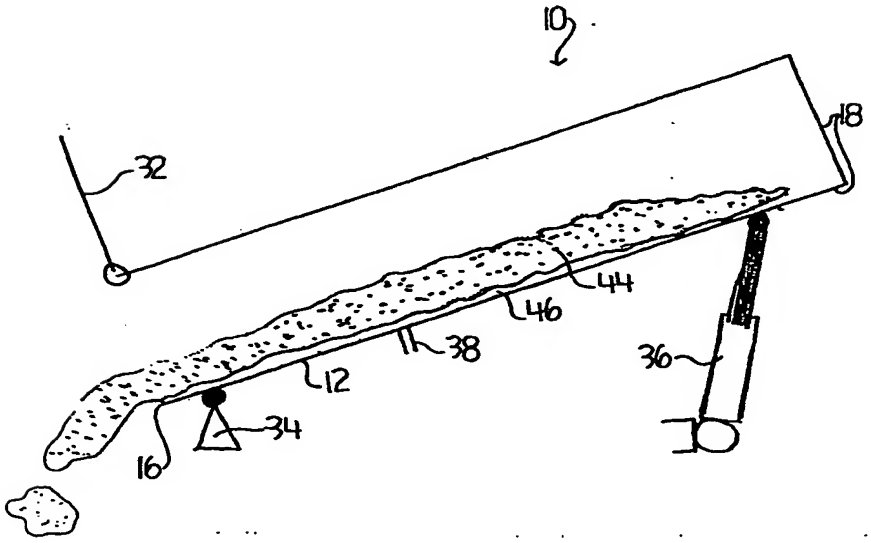


FIGURE 4

ABSTRACT OF THE DISCLOSURE

A method of separating oil and bitumen from sand. Firstly, mixing sand containing oil and bitumen with water in a tank to form an aqueous slurry. Secondly, adding a water solution of hydrogen peroxide to the aqueous slurry and agitating the aqueous slurry. The hydrogen peroxide serves as a catalyst initiating a vigorous reaction that separates the aqueous slurry into an upper froth layer, a middle clean water layer and a lower clean sand and clay layer. Thirdly, skimming the upper froth layer containing oil and bitumen and removing the lower clean sand layer and the middle clean water layer from the tank.

TITLE OF THE INVENTION:

method of separating oil and bitumen from sand

NAMES OF INVENTORS:

Earl Gingras
Paul Belanger

FIELD OF THE INVENTION

The present invention relates to a method of separating oil and bitumen from sand. The method has application to primary or secondary treatment of tar sands, the treatment of tailings from various mining or drilling processes, and environmental clean up operations.

BACKGROUND OF THE INVENTION

There are various applications in which it is desirable to separate oil and bitumen from sand. One prominent example is the "tar sands". The tar sands are deposits having, on a mass percentage basis, silica sand as the principal component. These deposits have a bitumen content of approximately 10%. They also contain fines (mostly clays), and a few other minerals in trace amounts. Another example is recovery from "heavy oil" wells. Steam is injected into a well to allow heavy oil deposits to flow. The heavy oil brought to surface is mixed with sand. After primary separation, the sand remains contaminated with an oil and bitumen content of 4%-7%.

In broad terms, the methodology for separating oil and bitumen from sand involves the following steps. Firstly, adding water to form an aqueous slurry. Secondly, heating the aqueous slurry to make the oil and bitumen less viscous.

Thirdly, subjecting the aqueous slurry to agitation, thereby causing separation into an upper froth layer, a middle layer of waste slurry and a lower sludge layer with residual oil and bitumen content. Oil and bitumen are skimmed from the upper froth layer for further processing.

Through the years, various techniques have been tried to improve separation. One technique is to add chemicals, such as sodium hydroxide. Sodium hydroxide is a chemical that draws surfactants out of the tar sands which assist in separating the bitumen. Another technique is to use aeration to increase the volume of the upper froth layer. Other techniques have aimed at maximizing the use of resources in order to make the process more efficient. These techniques involve such practical measures as recycling water used in the process. Regardless of the technique employed, a residual oil and bitumen content is always left in the sand and a portion of the water remains contaminated by fines.

SUMMARY OF THE INVENTION

What is required is a method of separating oil and bitumen from sand that overcomes the inadequacies of present methods by reducing or eliminating any residual contamination in sand and water.

According to the present invention there is provided a method of separating oil and bitumen from sand. Firstly, mixing sand containing oil and bitumen with water in a tank to form an aqueous slurry. Secondly, adding a water solution of hydrogen peroxide to the aqueous slurry and agitating the aqueous slurry. The hydrogen peroxide serves as a catalyst initiating a vigorous reaction that separates the aqueous slurry into an upper froth layer, a middle clean water layer and a lower clean sand and clay layer. Thirdly, skimming the upper froth layer and removing the lower clean sand layer and the middle clean water layer from the tank.

The method, as described above, is an enhanced froth floatation separation process. With this method, secondary treatment of sand containing oil and bitumen has resulted in the sand being cleaned to such an extent that it is suitable for use in industrial applications. The separation of solids has been so complete that solids of differing densities form in layers. Water used in the process has remarkable clarity, and can be repeatedly recycled. The process is a batch process that works far better than one could reasonably predict. It is not fully understood why the separation method described above is so complete. What is apparent is that the hydrogen peroxide serves as a catalyst to a vigorous reaction; resulting in a remarkable degree of separation. The use of hydrogen peroxide leaves no harmful residue.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings, wherein:

FIGURE 1 is perspective view of a tank used in accordance with the teachings of the present method.

FIGURE 2 is an end elevation view, in section, of the tank illustrated in **FIGURE 1**.

FIGURE 3 is a first side elevation view of the tank illustrated in **FIGURE 1**, in a first position with separation into layers having occurred.

FIGURE 4 is a second side elevation view of the tank illustrated in **FIGURE 1**, in a second or inclined position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred method of separating oil and bitumen from sand will now be described with reference to **FIGURES 1** through

4.

Referring to FIGURE 1, the method consists of the following steps. Firstly, providing a tank 10 having a bottom 12 and sidewalls 14 that diverge upwardly and outwardly from bottom 12. Referring to FIGURE 3, tank 10 has a first end 16 and a second end 18. Referring to FIGURE 2, a gas injection assembly, generally identified by reference numeral 20, is positioned at bottom 12 of tank 10. Gas injection assembly 20 is used to inject agitating gas bubbles, as will hereinafter be further described. Gas injection assembly 20 includes a ceramic aeration sheet 22 that is supported by a plurality of support rods 24 thereby defining a plurality of gas chambers 26. A protective metal cover sheet 28 overlies ceramic aeration sheet 22. Metal cover sheet 28 has a plurality of slots 30, through which gas passes. Referring to FIGURE 4, a gate 32 is positioned at first end 16. Gate 32 is movable between an open position, as illustrated in FIGURE 4, and a closed position, as illustrated in FIGURE 3. Referring to FIGURE 4, tank 10 is pivotally mounted on a base 34 positioned at bottom 12 adjacent first end 16. An hydraulic jack 36 is used as lifting means. Hydraulic jack 36 is positioned at bottom 12 of tank 10 adjacent second end 18. Second end 18 is lifted by hydraulic jack 36 to pivot tank 10 to an inclined position, as illustrated in FIGURE 4.

Secondly, sand containing oil and bitumen is mixed with water in tank 10 to form an aqueous slurry. The mixing is accomplished by injecting gas through hoses 38 into gas injection assembly 20. The amount of water added must be at least one part water for every one part of sand to provide a proper slurry. It is preferred that the aqueous slurry be heated to make the oil and bitumen less viscous, but that is not essential to the successful application of the method. Thirdly, a water solution of hydrogen peroxide is added to the aqueous slurry. There should be at least one half (1/2) percent hydrogen peroxide has been added by volume for every

100 parts of sand by volume. Aqueous slurry is agitated by injecting bubbles of gas through air injection assembly 20. Referring to FIGURE 2, the hydrogen peroxide serves as a catalyst initiating a vigorous reaction that separates the aqueous slurry into an upper froth layer 40, a middle clean water layer 42 and a lower clean sand layer 44 and clay layer 46. The bubbles of gas passing through the air injection assembly 20 serves to assist in carrying oil and bitumen to upper froth layer 40. Fourthly, referring to FIGURE 1, upper froth layer 40 is skimmed through skimming ports 48 in sidewalls 14. Middle clean water layer 42 is drained from tank 10 through a drainage port 50 in sidewall 14 and is recycled. Fifthly, referring to FIGURE 4, gate 32 is placed in the open position and hydraulic jack 36 is used to lift second end 18 to pivot tank 10 to the inclined position. Air injection assembly 20 is then used to gas assist the dumping of lower clean sand layer 44 and clay layer 46.

In order to test the efficacy of the described method, a 150 litre tank 10 was constructed. An air compressor was used to deliver 3 cubic feet per minute of air through hoses 38 to gas injection assembly 20. 9 litres of sand was added to tank 10. The sand used was contaminated with 7.2% oil and bitumen by dry weight. An aqueous slurry was created by adding 50 litres of water. The temperature of the aqueous slurry was raised to 45 degrees celsius. The time of each test was a uniform 30 minutes. A first test was conducted with no hydrogen peroxide was added. The residual oil and bitumen content in the sand after processing was .31% dry weight. A second test was conducted with a 35% solution of hydrogen peroxide added in a quantity ~~in which~~ hydrogen peroxide constituted 1% of the volume of the sand. The residual oil and bitumen content in the sand after processing was .14% dry weight. A third test was conducted in which the quantity of hydrogen peroxide was increased to 1 1/2%. The residual oil and bitumen content in the sand after processing was .11% dry weight. Some smaller scale tests were performed with hydrogen

peroxide content of as high as 3%. The residual oil and bitumen content in the sand after processing on the smaller scale test was .04% by dry weight.

The batch method, as described, greatly reduces the residual oil and bitumen content remaining in the sand after processing. The water is sufficiently clean that it be recycled. The solids are sufficiently clean that the sand, which is silica sand, can be used in glass production and other industrial applications.

It will be apparent to one skilled in the art that modifications may be made to the illustrated embodiment without departing from the spirit and scope of the invention as hereinafter defined in the Claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of separating oil and bitumen from sand, comprising the steps of:

firstly, mixing sand containing oil and bitumen with water in a tank to form an aqueous slurry;

secondly, adding a water solution of hydrogen peroxide to the aqueous slurry and agitating the aqueous slurry, whereby the hydrogen peroxide serves as a catalyst initiating a vigorous reaction that separates the aqueous slurry into an upper froth layer, a middle clean water layer and a lower clean sand and clay layer; and

thirdly, skimming the upper froth layer and removing the lower clean sand layer and the middle clean water layer from the tank.

2. The method as defined in Claim 1, agitating the aqueous slurry by injecting bubbles of inert gas at a bottom of the tank.

3. The method as defined in Claim 1, having at least one half percent hydrogen peroxide added by volume for every 100 parts of sand by volume.

4. The method as defined in Claim 2, having a tank that has sidewalls that diverge upwardly and outwardly from the bottom.

5. The method as defined in Claim 1, having a tank that has bottom, a first end and a second end, a gate being positioned at the first end, the gate being movable between an open position and a closed position, the tank being pivotally mounted on a base positioned at the bottom adjacent the first end, lifting mean being positioned at the bottom adjacent the second end, such that when the lifting means is actuated with the gate in the open position, the tank pivots to an inclined position whereupon the lower clean sand layer is dumped.

6. A method of separating oil and bitumen from sand, comprising the steps of:

firstly, providing a tank having:

a bottom, sidewalls that diverge upwardly and outwardly from the bottom, a first end and a second end;

means for injecting gas at the bottom of the tank;

a gate positioned at the first end, the gate being movable between an open position and a closed position;

the tank being pivotally mounted on a base positioned at the bottom adjacent the first end;

lifting means being positioned at the bottom adjacent the second end whereby the second end of the tank is lifted by the lifting means to pivot the tank to an inclined position;

secondly, mixing sand containing oil and bitumen with water in the tank to form an aqueous slurry;

thirdly, adding a water solution of hydrogen peroxide to the aqueous slurry until at least one half percent hydrogen peroxide has been added by volume for every 100 parts of sand by volume and agitating the aqueous slurry by injecting bubbles of gas through the means for injecting gas at a bottom of the tank, whereby the hydrogen peroxide serves as a catalyst initiating a vigorous reaction that separates the aqueous slurry into an upper froth layer, a middle clean water layer and a lower clean sand and clay layer, with the bubbles of gas assisting in carrying oil and bitumen to the upper froth layer; and

fourthly, skimming the upper froth layer and draining the middle clean water layer from the tank; and

fifthly, opening the gate and actuating the lifting means to pivot the tank to the inclined position and using the means for injecting gas for a gas assisted dumping of the lower clean sand layer.